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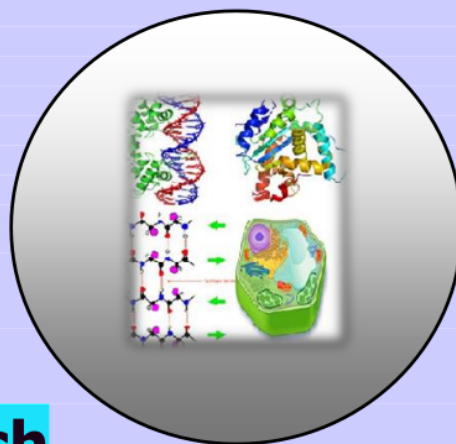
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RESEARCH PAPER

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Characteristics of Balinese Traditional Food *Pedetan* with Plastic Packaging in Storage

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ABSTRACT

Pedetan is a traditional Indonesian food made from sardine fish (Sardinellalongiceps) flavored, and dried in the sun, then stored at room temperature only use baskets or bamboo so that the shelf life of pedetan relatively low. Packaging and storage headwinds it is necessary to investigate and assess the best packaging materials that can produce quality pedetan. The study was conducted in Denpasar and pedetan material obtained from the Melaya village, Jembrana regency of Bali. In this research, packaging using packaging material of plastic, by means of vacuum plastic, Polypropylene plastic, and mica plastic, then stored for six months and observed every month to changes Total Volatile Bases, Tri Methyl Amine, Total Plate Count, Water Content, pH and organoleptic assessment based on SNI. The results showed that pedetan are packed with Polypropylene plastic can alternatively storage with TVB value of 44.45 mg N/100g, TMA value of 46.75 mg N%, Water Content of 17.51%, pH of 6.32, TPC of 15.22 10³CFU/g and In organoleptic with average value average above 7, still meet the requirements of the Indonesian National Standard (SNI). These results indicate that pedetan packaged plastic still able to maintain the quality and food safety.

Keywords–Traditional Food pedetan, TVB and TMA.

INTRODUCTION

Pedetan is a kind of traditional Balinese food products dried fish that is processed by the people in the area Jembrana Bali province. Pedetan made of sardine fish (Sardinellalongiceps) which are produced in the coastal areas Jembrana. Sardine is the process into a food product that can be stored longer. Local communities usually do not

consume these fish directly, because it is considered less palatable taste, and smell bad stinging. There are two common ways by the local community in making *pedetan*, namely by direct drying in the sun and drying in the oven, fireplace, then dried in the sun (Singapurwa et al., 2014). Traditional food treatment has been developed as an alternative to the prospect of leveling distribution between producing areas and consumer areas (Ryder et al., 2014).

Pedetan made of sardine fish, salt and spices (pepper, red pepper, coriander, galangal, ginger, garlic and brown sugar), dried in the sun for three to five days, then stored at room temperature. At the time of storage *pedetan*, people usually only use baskets, or bamboo, or left in the open condition so that the shelf life of fish *pedetan* relatively low, only able to be stored for 4-8 weeks, with an average water content of 15.40 %, protein content of 55.57 %, fat content of 1.24 %, ash content of 8.57%, and total microbial of 11.76×10^3 CFU/g (Singapurwa et al., 2014).

The problem faced by processing salted fish is the decrease in raw material and low quality of the processed salted fish, especially in terms of packaging (Hendrik, 2010). Headwinds short shelf life of traditional food *pedetan* it is necessary to investigate and review of plastic packaging materials and storage duration with regard hygiene sanitation so that people can make *pedetan* as a food source of protein and is expected to *pedetan* as an alternative food for food security. This study aims to determine the approach to plastic packaging for *pedetan* storage.

MATERIAL AND METHODS

The study was conducted from January to August 2015 with the sampling carried out in Melaya village, the village that produces the best *pedetan* from the previous year's study. Samples are packed into three kinds of plastic packaging materials, namely Vacuum Plastic, Polypropylene Plastic and Mica Plastic, each stored for six months, and every month analyzed objectively and subjectively.

Objective analysis carried out Test TVB (Total Volatile Base) (NSA, 2010), Test TMA (Tri Methyl Amin) (NSA, 2010), degree of acidity (pH), Test TPC (Total Plate Count) (NSA, 2011), and a subjective test sensory quality (Appearance, Aroma, Taste, Texture and Fungus), based on SNI (Indonesian National Standard) 2721.1.2009 (NSA, 2009).



Figure 1. *Pedetan* packaging commonly used community.

Analysis of data obtained from the results of subsequent studies analyzed by analysis of variance with SPSS.

RESULTS AND DISCUSSION

A. Total Volatile Base

Analysis of variance of the TVB, the treatment and storage time of packaging materials show significantly different. From the results of further testing with Duncan showed that the packaging material significantly different Polypropylene with Vacuum plastic and mica plastic, but the packaging materials and vacuum plastic with mica plastic were not significantly different. The average value of TVB for Vacuum plastic Packaging is 58.248 mg N/100 g, Polypropylene plastic packaging is 44.544 mg N /100 g, Mica Plastic packaging is 53.525 mg N/100 g (Table 1).



Figure 2. *Pedetan* with vacuum plastic packaging.

The average value of TVB for all packaging materials during storage first month at 58.907 mg N/100g, the second month amounted to 42.992 mg N/100 g, the third month amounted to 46.145 mg N/100 g, fourth month amounted to 51.647 mg N/100 g, fifth month amounted to 54.550 mg N/100 g and sixth month amounted to 58.395 mg N/100 g (Table 2). TVB values differ depending on the type of fish, even similar fish also have a different value TVB. TVB value for all treatments showed a high enough value, it indicates that there has been damage to the fish protein. The longer it is stored will increase the value of TVB (Murtiniet al., 2014). TVB due to the high value of fish protein has been degraded by microorganisms and due to enzyme activity. TVB-N is accepted universally as an indicator of quality that uses ammonia. The highest TVB-N values were observed in dry fishes during monsoon season and it ranged from 20.28 to 38.26 mg/100 g. The acceptability level of TVB-N in dried fish is 35 - 40 mg/100 g as the upper limit and above that level fishery products are considered unfit for human consumption. In post monsoon season TVB-N values ranged from 15.77 – 22.72 mg/100 g and 9.90 – 19.20 mg/100 g in summer. TVB-N measurement indicates the extent of the breakdown of protein due to bacterial and enzymatic action leading to amine production. The enzyme from the spoilage microorganism can metabolize the amino acids of the fish muscle producing ammonia, trimethylamine, dimethylamine (total volatile base nitrogen) which is used to estimate spoilage. The TVB-N level in fish has also been used to indicate the growth of microorganisms leading to spoilage.

¹ The TVB-N level of fish in retail market was as high as 98 mg/100 g. the TVB-N level of dried fishes in Tuticorin market was 30 -18.4, 18.95 - 14.81, 9.31 - 14.14 mg/100 g in monsoon, post monsoon and summer season respectively. TVB-N level of the *S. fimbriata* stored at 20°C for 24 hours was 23.9 mg/100 g and it increased to 53.6 mg during 4 days of storage (Immaculate et al., 2013).

TVB-N values would be “high quality” up to 25 mg/100 g, “good quality” up to 30 mg/100 g, “limit of acceptability” up to 35 mg/100 g, and “spoilt” above 35 mg/100 g. The average TVB-N of yellow fish tuna and sardine was below the rejection limits. The TVB-N of one sample of sailfish was recorded as 1021 mg N/100 g of fish, without that sample, the average TVB-N value of sailfish was 25 mg N/100 g (Jinadasa, 2014).



Figure 3. *Pedetan* with polypropylene plastic packaging.



Fig. 4 *Pedetan* with mica plastic packaging.

Table 1. Objective Analysis For Packaging.

Packaging	TVB (mg N /100 g)	TMA (mg %)	Water Content (%)	pH	TPC (CFU/g)
Vacuum Plastic	58.248b	46.813a	15.676a	6.350 a	0 a
PP	44.544a	46.752a	17.507b	6.317 a	1.52 10 ³ ab
Mica Plastic	53.525b	48.502a	18.082b	6.317 a	2.80 10 ³ b

B. Tri Methyl Amine

Analysis of variance of the TMA, in the treatment and storage time of packaging materials show no significant difference. The average value of TMA for Vacuum plastic packaging is 46.813 mg N%, Polypropylene plastic packaging is 46.752 mg N%, and Mica plastic packaging is 48.502 mg N% (Table 1). Polypropylene plastics have the lowest value of TMA due to the possibility of plastic Polypropylene is able to inhibit the growth of microorganisms that cause damage to the fish and the formation of TMA.

The average value of TMA for all packaging materials during storage first month at 47.172 mg N%, the second month amounted to 46.897 mg N%, third month amounted to 54.877 mg N%, the fourth month amounted to 49.763 mg N%, fifth month amounted to 44.935 mg N% and sixth month amounted to 40.492 mg N% (Table 2). TMA value increased until the storage third month and decreased until the storage sixth month. TMA is part of TVB therefore TMA content is always lower than TVB. TMA is the result of the reduction of TMAO by enzymes. In the case of fish spoilage, microorganisms utilize oxygen atoms donated by TMAO under anaerobic conditions and lead to increased formation of TMA (Koralet *al.*, 2016).

C. Water Content

Analysis of variance for Water Content, in the treatment and storage time of packaging materials, showed significantly different. The average value of the moisture content of the Vacuum plastic packaging is 15.676%, Polypropylene plastic packaging is 17.507% and Mica plastic packaging 18.082% (Table 1). From the results of further testing by real difference test Duncan, showed *Pedetan* in vacuum plastic packaging significantly different from those in the Polypropylene plastic packaging and Mica Plastic packaging. Vacuum plastics have the value of the lowest water levels likely due to the low permeability of plastic, as well as in vacuum conditions, no air in the packaging. Thin plastic packaging that with the water vapor permeability greater, the rate of water vapor into the packaging and the greater the rate of change of moisture content faster product (Wulandari *et al.*, 2013). Storage space humidity between 61% - 86%, and room temperature is 30.1°C -35.7°C. This led to high RH water vapor pressure gradient between the air storage environment with greater *pedetan* so that the absorption of moisture from the ambient air into the greater *pedetan*.

The average value of the moisture content for all the packaging material during storage at 16.574% for first month, the second month by 15.870%, the third month amounted to 15.621%, the fourth month amounted to 17.164%, fifth month amounted to 18.626% and sixth month amounted to 18.674% (Table 2). The value average of the water content increase during storage sixth months. From the results of further testing with difference test Duncan, showed the water content of first to fourth months of storage significantly different from the storage fifth and sixth month. An increase in moisture content during storage due to the nature of plastic packaging permeability to humidity, light and temperature, affect the degradation, physical changes and concentration, which can result in the growth of microorganism (Malhotra *et al.*, 2015). The water content in all treatments in this study still meet the requirements of SNI 2721.1: 2009 is a maximum of 40% (NSA, 2009).

D. Degree of Acidity (pH)

Analysis of variance of degree of acidity (pH), the treatment of packaging materials and storage time showed no significant difference. The average value of pH to the Vacuum Plastic packaging is 6.350, Polypropylene plastic packaging is 6.317 and Mica plastic packaging is 6.317 (Table 1). The value average of pH for all the packaging material during storage at 6.317 for the first month, the second month of 6.333, the third month of 6.367, the fourth month of 6.283, the fifth month of 6.350 and sixth month of 6.317. The pH can be used as a spoilage indicator of fish and fish products. The pH of fresh fish after death is usually reported as close to neutral and varies between 6.0 and 7.1 during post-mortem storage depending on the fish species, diet, season, type of muscle, and other factors. The pH of fresh shad was recorded as 6.8. The pH values reached 7.18 at the time of spoilage. Although the increase in pH values correlates well with the spoilage during storage, the values do not support sensory values. Although different authors obtained lower pH values for fresh shad species, they likewise obtained similar trend for pH values during spoilage [10]. The pH level was 4.42, 4.72 and 4.77 in the brine, oil and vacuum packaged samples at 210 days, respectively and there were no significant differences between groups. The pH of fresh raw fish was initially approximately 6.30 and then changed during the maturation process to 4.29 after 90 days (Erdemet *et al.*, 2015).

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E. Total Plate Count (TPC)

Analysis of variance for Total Plate Count, the treatment showed significantly different packaging materials, while the storage duration of treatment showed no significant difference. From further testing with different test Duncan showed that treatment vacuum plastic packaging is no different from Polypropylene plastic packaging, but significantly different with Mica plastic packaging. The average value of the TPC for the packaging material Plastic Vacuum was 0CFU/g, Polypropylene plastic packaging is 1.52×10^3 CFU/g and Mica plastic packaging is 2.80×10^3 CFU/g (Table 1). From the results of further testing with difference test Duncan showed *Pedetan* in vacuum plastic packaging is not significantly different from the Polypropylene plastic packaging but significantly different packaging with Mica plastic packaging. Vacuum plastics have the value of zero TPC likely due to the low permeability of plastic, as well as in vacuum conditions, no air in the packaging and does not allow for the growth of microorganisms.

20 **Table 2 Objective Analysis for Storage Time.**

Storage Time	TVB (mg N/100 g)	TMA (mg N%)	Water Content (%)	pH	TPC (CFU/g)
1 st month	58.907c	47.172a	16.574 ab	6.317 a	2.902×10^3 a
2 nd month	42.992a	46.897a	15.870a	6.333 a	1.05×10^3 a
3 rd month	46.145ab	54.877a	15.621a	6.367 a	1.12×10^3 a
4 th month	51.647ab	49.763a	17.164 ab	6.283 a	1.75×10^3 a
5 th month	54.550b	44.935a	18.626 b	6.350 a	9.63×10^2 a
6 th month	58.395c	40.492a	18.674 b	6.317 a	8.60×10^2 a

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The average value of the TPC for all packaging materials during storage the first month at 2.902×10^3 CFU/g, the second month amounted to 1.05×10^3 CFU/g, the third month amounted to 1.12×10^3 CFU/g, the fourth month amounted to 1.75×10^3 CFU/g, fifth month at 9.63×10^2 CFU/g and sixth month amounted to 8.60×10^2 CFU/g (Table 2). Total Plate Count value for all treatments in this study still meet the requirements of SNI 2721 1:2009 is a maximum of 1.0×10^5 CFU/g. the seasoning on *pedetan* such as garlic, salt and sugar also serves as an antimicrobial compounds, so as to suppress the growth of microbes. Drying is done by sunlight is intended for preservation, obtaining food products are safe for consumption, in terms of microbiological and organoleptic quality (Hastuti and Hidayati, 2010). Some traditional food preservation techniques like drying, freezing, heating, fermentation, salting can extend the shelf-life of food products, but recontamination may occur that may render the food unpalatable for the consumers. The antimicrobial packaging system is a novel development which incorporates antimicrobial agent into a polymer film to suppress the activities of targeted microorganisms that are contaminating foods (Mslhotra et al., 2015).

A maximum number of bacteria and fungi recorded in monsoon season confirms that moisture leads to contamination of dried fishes. Further enumeration of pathogens in fish proved that the fish intended for drying were putrefied and not intended for human consumption. Since the quality of the cured fishes is poor, even the salt that was used to preserve the fish was considered ineffective. Hence control measures such as use of good quality raw material, good quality salt, hygienic handling practices, potable water, recommended process, good quality packaging material, hygienic processing place may be considered to improve the quality of the dried fishes. Finally low moisture level of the product and proper storage conditions will help to improve the quality. For conventional drying, hygienic fish drying racks should be used or else the fishes can be dried using solar dryer to reduce the microbial and insect infestations (Immaculate et al., 2013).

F. Organoleptic of Appearance

Analysis of variance of the appearance, the packaging material treatment showed no significant difference and storage time showed a significantly different effect. The average value *pedetan* appearance to the Vacuum plastic packaging is 8.311, Polypropylene plastic packaging is 8.289 and Mica plastic packaging is 8.233 (Table 3). Vacuum plastics have the highest probability value appearance due to the low permeability of plastic, as well as in vacuum conditions, no air in the packaging. The average value for all the appearance of the packaging material during storage at 8.444 for first month, the second month of 8.578, the third month of 8.311, the fourth month of 7.956, the fifth month of 8.089 and sixth month of 8.289 (Table 4). From the results of further testing with difference test Duncan, appearance retention first and second months significantly different from third month of storage and significantly different from the storage of fourth to sixth months. The average value of the appearance of the organoleptic test is in the range of 8-9, with the characteristics intact, clean, blowzy, polish to shine. The average value of the appearance of the organoleptic test still meet the requirements of SNI 2721 1: 2009 at least 7 (NSA, 2009).

The sensory scores of marinated shad fillets indicated a good quality of the storage period. For marinated chub mackerel horse mackerel, sardine and anchovy packaged in jars with vegetable oil and vacuum packed in polyethylene bags, then stored at $4 \pm 1^\circ\text{C}$.

There were not quality changes on sensory analysis of marinated anchovy throughout storage time. Many studies showed that good quality marinated fish between 3 and 6 months (Erdem et al., 2015).

G. Organoleptic of Aroma

Analysis of variance of the Aroma, the treatment and storage of packaging materials show significantly different. The average value of scent to the Vacuum Plastic packaging is 8.567, Polypropylene plastic packaging is 8.244 and Mica plastic packaging is 8.189 (Table 3). The results of further testing by real difference test Duncan showed aroma *pedetan* with vacuum plastic packaging significantly different with Polypropylene plastic packaging and Mica plastic packaging.

Table 3. Subjective Analysis for Packaging.

Packaging	Appearance	Aroma	Taste	Texture	Fungus
Vacuum Plastic	8.311 a	8.567 b	8.022 b	8.144 b	9.000 a
PP	8.289 a	8.244 a	7.578 a	7.900 a	9.000 a
Mica Plastic	8.233 a	8.189 a	7.467 a	7.878 a	9.000 a

The average value of scents for all the packaging material during storage at 8644 first month, the second month of 8711, the third month of 8622, the fourth month of 8133, the fifth month and sixth month of 7956 amounted to 7,933 (Table 4). From the results of further testing with difference test Duncan showed aroma on storage of first to third months significantly different from the storage of fourth to sixth months. The average value of aroma on organoleptic test is in the range of 8-9, with the characteristics of less fragrant until fragrant, without additional flavor to specific types without additional flavor. The average value of aroma on organoleptic test still meets the requirements of SNI 2721 1: 2009 at the least 7 (NSA, 2009).

H. Organoleptic of Taste

Analysis of variance of the taste, the treatment and storage time of packaging material showed significantly different. The average value of taste to the Vacuum plastic packaging is 8.022, Polypropylene plastic packaging is 7.578 and Mica plastic packaging is 7.467 (Table 3). From the results of further testing with difference test Duncan, showed *pedetan* taste with vacuum plastic packaging significantly different with Polypropylene plastic packaging and Mica plastic packing.

The average value of flavor to all the packaging material during storage at 7.911 for first month, the second month of 7.778, the third month of 7.822, the fourth month of 7.711, the fifth month of 7.689 and sixth month of 7.222 (Table 4). From the results of further testing by real difference test Duncan showed on the storage of first to fifth months significantly different from sixth months of storage. The average value of the appearance of the organoleptic test is in the range of 7-9 with characteristics good to very good at all, the specific types, without additional food additive. The averaged value of a sense of the organoleptic test still meet the requirements of SNI 2721 1: 2009 at least 7 (NSA, 2009). Salted fish were stored for 210 days in salt water, oil and vacuum resulted in the appearance, flavor, odor and texture were significantly different (Erdem et al., 2015).

I. Organoleptic of Texture

Analysis of variance of the texture, the treatment and storage time of packaging materials show significantly different. The average value of the texture to the Vacuum Plastic packaging is 8.144, Polypropylene plastic packaging is 7.900 and Mica plastic packaging is 7.878 (Table 3). From the results of further testing by real difference test Duncan on the texture with PP plastic packaging is not significantly different from the mica plastic, but different with vacuum plastic packaging. This may be influenced because the mica plastic material content of consists of Polypropylene, Polyethylene and Poly Vinyl Chloride, which still contains Polypropylene plastic, causing the texture of the packaged product is no different. Vacuum plastic material consists of Low-Density Polyethylene plastic material and Polyamine (Ryder *et al.*, 2014). The average value of textures for all the packaging material during storage at 8.378 for first month, the second month of 8.156, the third month of 7.933, the fourth month of 7.844, the fifth month of 7.733 and sixth month amounted to 7.800 (Table 4). From the results of further testing by real difference test Duncan, storage first month texture in contrast to the storage second months, and in contrast to the storage of 3 to 6 months. The averaged value of the texture on this organoleptic test in the range of 7-9 with a characteristic dense, compact, flexible, less dry until quite dry. The average value of the texture on the organoleptic test still meet the requirements of SNI 2721 1: 2009 at least 7 (NSA, 2009). Packaging that made from combination of few polymers has the tendency to impart greater interaction effect on the properties of packaging material. The packaging materials used for MAP are gas proof with multilayer films. Polyethylenes (PE), polypropylene (PP) are commonly used combination of polymers for the packaging material of MAP, PVC, PE, PP and polyethylene terephthalate are more commonly used for construction of MAP. The Poly Amide exists with the characteristics of relatively impermeable to oxygen and relatively permeable to water vapor, while other polymers are relatively permeable to oxygen and relatively impermeable to water vapor (Veluet *al.*, 2013).

Table 4 Subjective Analysis for Storage Time.

Storage Time	Appearance	Aroma	Taste	Texture	Fungus
1 st month	8.44cd	8.64a	7.91 b	8.38c	9.00a
2 nd month	8.58d	8.71a	7.78 a	8.16 bc	9.00a
3 rd month	8.31bcd	8.62a	7.82 a	7.93 ab	9.00a
4 th month	7.96a	8.13b	7.71 a	7.84a	9.00a
5 th month	8.09ab	7.96b	7.69 a	7.73a	9.00a
6 th month	8.29bc	7.93b	7.22 a	7.80a	9.00a

J. Organoleptic Fungus

Analysis of variance of the fungus, the treatment of packaging materials and storage time showed no significant difference. The average value of the fungus for Vacuum Plastic packaging materials, Polypropylene plastic packaging and Mica plastic packaging is 9 (Table 3). The average value of the fungus for all packaging materials for storage of first to sixth months amounted to 9 (Table 4). The average value of the fungus on organoleptic test still meet the requirements of SNI 2721 1: 2009 at least 7 (NSA, 2011), wherein the storage for sixth months with no plastic packaging no fungus growth.

The permeability of plastic polypropylene lower compared with polyethylene plastic. The permeability of plastic packaging material polypropylene and polyethylene different, causing severe effect, color, smell, and texture of each product will be different as well. Meanwhile, the storage at room temperature further accelerated the absorption of water vapor. Polypropylene plastic is better than polyethylene plastic for packaging materials (Mareta and Awami, 2011)

CONCLUSIONS

1. Sardine fish *Pedetan* are packed with vacuum plastic packaging, Polypropyleneplastic packagingand mica plastics packaging can extend the shelf life for sixth months with the results of objective and subjective assessment still meet the requirements of SNI 2721 1: 2009
2. Polypropylene plastic packaging can be applied as a packaging material during *pedetan* storage, because it produces the value of TVB, TMA, TPC and pH were not significantly different with Vacuum plastic packaging materials, but to maintain the water content can be packaged with a vacuum plastic packaging.

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